



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

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**North Carolina Board of Transportation  
Environmental Planning and Policy Committee  
Meeting Minutes for March 5, 2008**

A meeting of the Environmental Planning and Policy Committee (EPPC) was held March 5, 2008 at 8:30 AM in the Board Room (Room 150) of the Transportation Building. Board Member Nina Szlosberg chaired the meeting. Other Board of Transportation members that attended were:

Alan Thornberg  
Arnold Lakey  
Tony Dennis  
Marion Cowell  
Nancy Dunn

Andrew Perkins  
Doug Galyon  
Mac Campbell  
Cam McRae  
Conrad Burrell

Other attendees included:

Debbie Barbour  
David Brook  
Bill Gilmore  
Wally Bowman  
Greg Burns  
Shakira Crandol  
Donna Dancausse  
Eddie Dancausse  
Marshall Dobson  
Jennifer Garifo  
Lisa Glover  
Larry Goode  
Ricky Greene  
Richard Hancock

Phil Harris  
Julie Hunkins  
Berry Jenkins  
Tim Johnson  
Drew Joyner  
Daniel Keel  
Shannon Lasater  
Don Lee  
Grady McCallie  
Ehren Meister  
Mike Mills  
Barry Moose  
Beth Neely  
Mike Pettyjohn

Linda Rimer  
Bill Rosser  
Michael Savonis  
Amy Simes  
Libby Smith  
John Sullivan  
Marie Sutton  
Jay Swain  
Cheryl Teeters  
Dan Thomas  
Greg Thorpe  
Gus Tulloss  
Don Voelker

Ms. Szlosberg called the meeting to order and circulated the attendance sheet. Ms. Szlosberg accepted a motion to approve the meeting minutes from the February 2008 committee meeting. The minutes were approved as presented.

Michael Savonis, FHWA, presented findings from the upcoming report, "Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I".

Ms. Szlosberg introduced the subject and posed the question how climate change in the world will affect us in North Carolina. All of us with decision-making responsibilities have to make decisions that will have long-term implications, whether it is a road project that should have a 40-year or 50-year life or a bridge that needs the same, or a transit system that may reduce our carbon footprint. It is important to have a better understanding of the subject so that decisions can be made that will be good decisions as we move into the future. There are a number of organizations in the state working on this issue, (e.g., the 21<sup>st</sup> Century Transportation Committee, the Interagency Leadership Team).

John Sullivan, FHWA - NC Division Administrator, introduced Michael Savonis, an expert on climate change who has taken the work of the international committee and their assessments and filtered that down to the transportation sector. Michael Savonis is the Air Quality Team Leader at FHWA – Headquarters. Mr. Savonis is evaluating and researching emerging issues, climate change being one of the emerging issues. There *is* climate change; but the exact number is unknown. What this study has done is use different scenario type analyses that will help inform us as we make decisions.

Mr. Savonis began his presentation by stating that the Gulf coast study is one of the Administration's major priority research activities. FHWA got interested in the topic of how climate change will affect transportation decisions. In general, FHWA is interested in the kinds of decisions that transportation professionals make on a daily basis—system planning and investment, project development, all the way through maintenance and operations. How will climate affect us, particularly what are some of the major drivers, and will it change the decisions that we might make as a transportation community, (e.g., where facilities are located, how well they are built?).

Coming from a transportation world, investment decisions are made. When you start looking at it from an investment capacity, you need a higher degree of certainty. You need to be able to have information that you can make decisions on. Some of those decisions can be very important.

Why is FHWA interested in this topic? Our transportation planning process does a good job trying to look 20 and 30 years into the future. The facilities that we build and invest in are in place for a much longer period. When a bridge is built, we want it to last 50 or 100 years. That's exactly the same timeframe that the climate is changing. That's what makes it so important for us to start considering climate and the climate changes in where facilities are located and how they are controlled.

As a research activity, FHWA wanted to know whether the study could bring in enough information with enough certainty to make determinations that might affect our decision-making. What was found was quite striking. The researchers found future scenarios could be bracketed, and that had serious implications on the way we do business.

The best way to look at this was take a case study. From an investment perspective, the

researchers wanted to look at much more specific information. A fairly large and fairly vulnerable area was chosen, running from Houston to Mobile, Ala. that included enough of the transportation activities so the study included two counties in from the coast to pick up all of the metropolitan areas—New Orleans, Houston, and Mobile. The researchers looked at the information and involved a team of scientists from the U.S. Geological Survey. It was a challenge bringing the climate scientists and transportation practitioners together—what information they could supply us with; what type of information would be most interesting.

What was found is that for overall climate impacts, there are four (4) major drivers relevant to transportation—accelerated sea level rise; increased storm surge and storm intensity; change in temperature; and changes in precipitation. Those are the things the researchers think will have important consequences.

In the Gulf coast, the story is temperature. It is an increase in average global temperatures that is concerning. The way it plays out from a transportation perspective is it's much more about water—changes in sea level rise, changes in the hydrologic cycle that can have an impact on transportation infrastructure.

Based on the best information available, average temperature is likely to increase by 2° to 4° F by 2050. What does it mean to have an average temperature rise of 2° to 4° F? From a transportation perspective it has some implications. More directly it means more hot days. According to our analysis, the number of days above 90° F in this region could increase by 50 percent.

Models show mixed results for changes in average precipitation. However, based on the literature, it does seem that the intensity of rainfall events is increasing and that can have an impact on equipment. The magnitude of impacts worsens as emissions increase.

What does this mean for the Gulf coast? Based on a series of future conditions, relative sea level will likely increase between one and six feet (this is based on two different models, four or five different scenarios, under several different conditions). What is happening in the Gulf coast is the land is sinking; this is not climate induced, it's a natural phenomenon that is occurring. On top of that, sea level is rising. The net impact of those two events is very serious for the Gulf coast which could see up to 6 feet of sea level rise.

Hurricane vulnerability is high today and may worsen. Sea surface temperatures are increasing and have increased since about 1910. What does this mean? When a hurricane hits the warm waters of the Gulf there's going to be an increase in intensity. As sea surface temperatures rise, the intensity of the storms are likely to go up.

The researchers have looked at the best data available, including emission scenarios. They looked at different years, under differing conditions for low, mid, and high, which are model specifications. They did not want to rely on one model and one future prediction. Instead, they wanted to bracket what the possible futures would be, look at the information that they could draw from that, and determine what the implications are. What they found is the central Gulf coast is particularly vulnerable to climate change. It's vulnerable today; that vulnerability will

worsen in the future due to climate change.

Let's look at this in an integrated manner; looking at sinking land masses in conjunction with rising seas. There are other types of effects; erosion for example, is another type of effect that needs to be looked at very closely.

And while I'd like to say there is a nice smooth progression from where we are today to where we will be in the future, I really can't say that. The planet record is filled with abrupt fits and starts, even reversals. So, the possibility of abrupt change cannot be ruled out.

What does this mean for transportation? Let's look at relative sea level rise. The researchers didn't want to look at just the extremes. They wanted to look at possible future scenarios. Instead of looking at 1' to 6' they looked at a middle range of 2' to 4'. Mr. Savonis discussed what happens at 4' sea-level rise. It is a very conservative estimate. More than a quarter of the major roadways in the study region (i.e., two-county region between Houston and Mobile) would be permanently inundated. In the Gulf coast that translates to at least 2,400 miles of roadways. Three-quarters of the freight and non-freight facilities in the port (at water-level already), because of their location freight lines are less impacted. Only 9 percent of the rail miles operated and 20 percent of the freight facilities at ports.

There are two caveats in this study, not fatal to the analysis. One is that the study looked at land elevations, not facility elevations. Many roadways are elevated. The study also did not look at the presence of levies or dikes. The central Gulf coast is in part protected by those levies and dikes, including the three airports that are within the levies in the New Orleans area.

It does negate the importance of the analysis because all of those facilities are dependent on the local roads. Airports are dependent on the local roads; rail lines are dependent on the ports. Those local roads are not elevated; there are all at land elevation. The researchers have confidence that these impacts are likely to happen.

[Mr. Savonis points to map of study area and shows enlarged portions in red that would be permanently inundated by rising sea levels in 50-100 years.] It is a very stark picture. It also has implications for how these precipitation events may impact as well. This will not all happen at once; this will be somewhat gradual. As there are heavy downpours, more intense rainfall events, there will be a zone, as the seas rise, of relative flooding. That will give us an early warning system knowing what facilities are at risk as we move forward with our investment scenarios.

Moving from sea level rise to storm surge—storm surge is the swirl of water that accompanies a hurricane. The study looked at vulnerability due to storm surge of 18' and 23'. Now, 18' is normally associated with a Category 5 storm. Many hurricanes have storm surges at 18' even if they are Category 3 or 4. Hurricane Katrina had a storm surge of 25'-30' at landfall.

At 18' of storm surge, more than half (51%) of interstate miles are at risk for temporary flooding. Temporary flooding is not the same level of impact. Nonetheless, with the transportation system

that increasingly serves just-in-time facilities, that serves as the nation's warehousing, that serves people's lives and needs, it becomes important to recover from those effects quickly. Almost all the port facilities (98%), about a third (33%) of the rail miles operated, and 22 airports are affected by storm surge of this level. There is also potential significant damage to offshore facilities (i.e., pipelines).

The study did not analyze storm surge for its potential to damage infrastructure. That has to be done at a facility-by-facility basis. That will be the next phase of this study. Nonetheless, hurricanes can have huge destructive forces. [Mr. Savonis points to a slide of a bridge (Hwy 90 outside of Bay St. Louis, MS) that was lifted off its moorings then crashed down in a domino effect. This bridge has now been rebuilt. It was 9' off the water and is now 85' in the air to avoid future storm surges.]

[Mr. Savonis points to a slide of temporary inundation that is possible for rail lines marked in yellow.] This picture is cumulative; flooding patterns will depend on which direction the storm makes landfall. Nonetheless, there are potentially significant impacts.

Temperature is the driver of climate change, but it is also an impact. Because of an increase in days above 90 and 100 degrees there could be a change in maintenance and operations in construction practices. Crews cannot be deployed in very high temperatures and that increases construction costs. Pavement wears out more quickly in days above 90 degrees. The amount of energy that is needed for refrigerated storage (for shippers) would increase. There's a potential rise in rail buckling, particularly for continuously welded rail. There may also be impacts to aircraft runway and performance. If you have very hot conditions your runway needs to be longer. The study was able to quantify this in the Gulf coast and found most of the airports were fine.

As important to our study is what to do going forward. Is this a part of our transportation planning? Should it be? And how can these ideas be incorporated in our transportation planning? For the people talked to in the Gulf region, few considered climate change in their transportation plans. With the advent of this report and similar reports that are coming out, that is probably likely to change.

From a federal perspective, they try to look 20 years into the future. These impacts are 50 to 100 years in the future and that may not be suited to our federal process. It may require some amendment or perhaps an add-on. Ultimately, we have to look at the system as a whole. The New Orleans region is a very important region in the nation. More than two-thirds of our oil imports come through the central Gulf coast. If those facilities go down, if oil cannot get into those facilities, we have a national problem.

A smaller study of potential impacts of sea-level rise on transportation infrastructure in North Carolina was also done. [Mr. Savonis points to a slide of the NC coast with 6 cm of sea level rise; that is 2"-3". Because of the low-lying nature of the land, the area in dark blue indicates what could be permanently flooded in land area and the light blue area is what is at risk for temporary flooding.] The amount of interstate, non-interstate arterials and rail that are at risk of

regular inundation at this level is fairly low (0% interstate, 2% non-interstate arterials, 1% rail). The study also looked at 48.5 cm of sea level rise (16"-20"); that is less than what the IPCC (Intergovernmental Panel on Climate Change) indicates in its fourth assessment (they go up to 23"). At 48.5 cm there is an increase in the amount of land area that is at risk of permanent inundation, but the total area is roughly the same. Now 2 to 6 percent of facilities, from the highway perspective, are being affected. The ports are significantly impacted by this level of sea level rise. This is a much less rigorous study than was done in the Gulf coast.

How do we go forward from this perspective? A lot of our decision making in transportation is fairly linear. Transportation professionals think about things they build for the worst case, or at least the average case, and they straight-line things out using professional judgment and good practice. What may be needed is to move more toward a risk assessment approach, trying to look at our exposure to vulnerabilities of our facilities and how resilient the network is. What may be needed is to look at adaptation responses; trying to protect the facilities better. There are things that we as transportation professionals can do to create greater resilience in our transportation network.

This report is due out any day; it has gone through extensive review. It will be submitted to Congress shortly.

**Questions:**

Andrew Perkins cites the cost to replace the Hwy 90 bridge and how does this study translate to the real world costs associated with now trying to do these put these facilities in a risk category to be able to alleviate these problems.

Mr. Savonis says this is the \$54,000 question. How to translate the findings of this study into the real world - into our environmental impact assessments - into our design for transportation facilities? We are just at the very beginning of the process. Because of this report and a report coming out from the Transportation Research Board at the same time, what the reports have done is raise awareness, that this is an important impact to start considering. The report goes further than to recommend what we should, as a community, to start to incorporate climate change considerations in our design of transportation facilities. How to do that is a matter of, right now, trial and error. Start to look at the facilities. Start to look at projects as they come up and try to incorporate some of the best thinking in that. I can't give you a more systematic answer.

Ms. Szlosberg asks what kinds of activities, what recommendations do you have for us as decision-makers in North Carolina?

Mr. Savonis advises to start looking at the system as a whole and from a climate perspective. The pictures of North Carolina, of the areas that are at risk where permanent inundation are likely to happen are a good place to start. Look at those roadways and transportation facilities and say what is it and what happens and start to do scenario planning in a way that will inform us as facilities are looked at and as they go through regular maintenance upgrades.

Transportation planning and investment process is a continuing, comprehensive, cooperative process, which always tries to take the next look—this is a natural add-on to that. As we continue in process identify what risks we face and how we might address them.

Ms. Szlosberg asks if in the future one of the criteria for long-range transportation plans will be considering climate change impacts.

There's a lot of concern. The federal process is a 20- to 30-year process, yet some of the impacts to the climate are longer-term than that 20-year process and more speculative as to what might be done about it. So fitting them into a fiscally constrained plan or something that is constrained, such as the air quality uniformity process, may or may not make sense at this point. What may be initiated is perhaps an add-on to planning. Something more scenario-based, future-oriented, saying what's at risk and let's look at this outside of that federal process.

John Sullivan commented that transportation is providing a service. So as this group and others talk about risk analysis, also need to look at what the transportation facility is serving and the risks associated with that. In the need to raise the bridge on US 90 they were looking at what they were serving and that became part of the risk. How long could they afford a facility being out of service as part of their risk analysis and investment decision? That would be something to look at in North Carolina. It is not about the transportation facility itself, but what is it serving and how well does that service need to be provided.

Andrew Perkins says risk analyses still have to be constrained by the dollar value of what you would be rebuilding. You are not going to have the economic resources to build to the future risk capacity. So these studies have to be real-world in terms of what does it cost and what is available to solve some of our problems today.

Mr. Savonis says the information has to be strong enough to act on then you have to decide can you afford that level of protection. In earthquake prone areas they go through extensive adaptation in order to create a more resilient network, and more resilient buildings, not only from a transportation perspective, but from a metropolitan perspective. That may be the kind of thing transportation professionals need to start looking at.

Ms. Szlosberg comments that the U.S. contributes disproportionately to the carbon load in the world. Does this assume that mitigation strategies are in place for reducing carbon and what are the assumptions?

Mr. Savonis says the study used four different emission scenarios. One was business as usual case – what happens if the current trajectory is maintained. The study also looked at what happens if they get worse, and what happens if they get significantly better, and what happens if they are curtailed. One of the more difficult problems in climate change is that it is a cumulative impact. The carbon dioxide that is emitted today will stay in the atmosphere for 100 years. As such, the concentration levels are projected to continue to increase. The hope in the IPCC is to contain that increase with doubling of CO<sup>2</sup> emissions. Even trying to do that, it will take a concerted effort by all of us to reduce our CO<sup>2</sup> emissions. Even if emissions could be magically

cut to zero today there will still be climate change impacts in 40 to 50 years. All of the emission scenarios indicate the same thing.

Ms. Szlosberg comments if certain mitigation strategies are assumed to be place, like reducing VMT, the use of hybrid cars, more use of transit, to get to the point of leveling, then a strategy is needed to get at least to these mitigation strategies.

Mr. Savonis comments the level of precision of the information is not that great. It is very difficult to say what is going to happen in 20, 30, 50 or 75 years – to give precise levels of impacts under certain condition scenarios. It would be pushing the information a little too far to try to determine that. Instead the researchers tried to ballpark a 50-100 year timeframe and say what is likely to happen within that timeframe, recognizing that emissions are likely to continue their increase, even at a decreased level. Conservative estimates were used to arrive at the 4' estimate of sea level rise.

Ms. Szlosberg asks if the work that FHWA is engaged in, will that include recommendations for state DOTs regarding mitigation strategies for car emissions. Mr. Savonis says it will not. Often, Mr. Savonis bills the Gulf coast report as “why the transportation community should care about climate change”. He believes the findings in the Gulf coast, the infrastructure that is at risk, the services that are at risk provides great impetus for us in the transportation world to care and to try to reduce our emissions so that infrastructure can last longer.

Linda Rimer, EPA, notes that at a climate change conference in Washington in January, an official from the Woods Hole Research Center made several points including his preference to use the term “climate disruption” as opposed to climate change. More importantly this [climate disruption] is not something that will hit us in 50-100 years—that we are seeing it now; and it is happening today. Maybe this drought is part of it. Can you comment on this?

Mr. Savonis thinks the term “climate disruption” is a good term because there is a lot of misconception about the linearity of climate change. There may be stronger storms, but not everywhere. There may be drought in certain places. There may be increases in snowfall in some places, even while the average temperature rises. Our model tends to be linear. Many want to know what will happen in 20 years. How bad will the sea level be in 20, 30, and 50 years? Unfortunately, the information is not that precise. The climate record is filled with fits and starts. There may not be a sea level rise over a 5-10 year period, and then there is double the rate that it was before then. The climate is a complex system. Weather is a complex system, and as the climate changes it becomes very difficult to forecast some of these impacts. Nonetheless, if you have confidence that in 50-100 years there is going to be sea level rise, you should take action now. The decisions that are being made now affect the location of new facilities. Decisions are made on a transportation basis everyday—to build new things, to build them in certain ways. And if you can build them better, build them smarter, build them in better protected locations, while serving your major constituents, you will have a more resilient network. It will cost less down the line. When you plan for what exposures the facility will be faced with, when you build it right the first time, it is cheaper than trying to build it a second time.

Ms. Szlosberg asks Mr. Savonis how would he suggest how to initiate research, work with FHWA, with academic institutions, to try to get better numbers on modeling for what might occur in North Carolina.

Mr. Savonis suggests bringing the climate scientists closer to the transportation practitioners. Just as has been done in storm surges, in figuring out how the natural environment affects our transportation facilities today, start looking at how you can predict what those natural conditions will be and bring that back to the transportation world. In our case, USGS partnered with us. FHWA asked questions, USGS provided answers. It was an iterative process. They got a better sense of what FHWA needed and FHWA got a better sense of what USGS could provide.

Ms. Szlosberg asked if there were further questions or comments. The meeting adjourned at 9:35 a.m.

The next meeting for the Environmental Planning and Policy Committee is scheduled for Wednesday, April 2, 2008 at 8:30 a.m. in the Board of Transportation Room (Room 150) of the Transportation Building.

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